

Precipitation

Reading Focus

Key Concepts

- What are the common types of precipitation?
- How is precipitation measured?

Key Terms

- precipitation
- drought
- cloud seeding
- rain gauge

Target Reading Skill

Using Prior Knowledge Before you read, write what you know about precipitation in a graphic organizer like the one below. As you read, write what you learn.

What You Know

1. Precipitation can be rain or snow.
- 2.

What You Learned

- 1.
- 2.

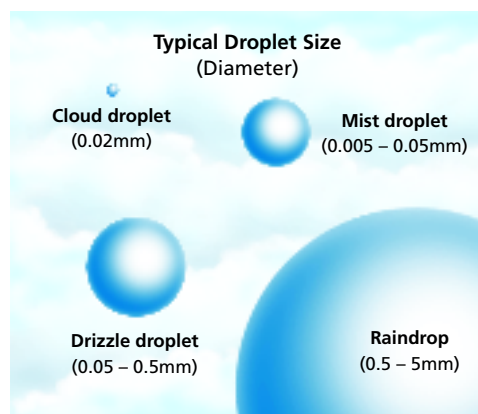


FIGURE 19

Water Droplets

Droplets come in many sizes. Believe it or not, a raindrop has about one million times as much water in it as a cloud droplet.

Discover Activity

How Can You Make Hail?

1. Put on your goggles.
2. Put 15 g of salt into a beaker. Add 50 mL of water. Stir the solution until most of the salt is dissolved.
3. Put 15 mL of cold water in a clean test tube.
4. Place the test tube in the beaker.
5. Fill the beaker almost to the top with crushed ice. Stir the ice mixture every minute for six minutes.
6. Remove the test tube from the beaker and drop an ice chip into the test tube. What happens?

Think It Over

Inferring Based on your observation, what conditions are necessary for hail to form?



In Arica, Chile, the average rainfall is less than 1 millimeter per year. But in Hawaii, the average rainfall on Mount Waialeale is about 12 meters per year. As you can see, rainfall varies greatly around the world.

Water evaporates from every water surface on Earth and from living things. This water eventually returns to the surface as precipitation. **Precipitation** (pree sip uh TAY shun) is any form of water that falls from clouds and reaches Earth's surface.

Not all clouds produce precipitation. For precipitation to occur, cloud droplets or ice crystals must grow heavy enough to fall through the air. One way that cloud droplets grow is by colliding and combining with other droplets. As the droplets grow larger, they move faster and collect more small droplets. Finally, the droplets become heavy enough to fall out of the cloud as raindrops.

Precipitation

Objectives

After this lesson, students will be able to

I.2.5.1 Identify the common types of precipitation.

I.2.5.2 Describe how precipitation is measured.

Target Reading Skill

Using Prior Knowledge Explain that using prior knowledge helps students connect what they already know with what they are about to read.

Answers

Possible answers include the following:

What You Know

1. Precipitation can be rain or snow.
2. Precipitation comes from clouds.

What You Learned

1. Sleet, freezing rain, and hail are forms of precipitation.
2. Droplets or ice crystals in clouds must grow heavy enough to fall through the air before precipitation occurs.

All in One Teaching Resources

- [Transparency I21](#)

Preteach

Build Background Knowledge

L1

Norse Mythology

Ask: Do you know what the expression "It's raining cats and dogs" means? (*That it's raining very hard*) Explain that the expression may come from old Norse myths, in which cats were identified with rain and dogs were identified with winds. Tell students that they will learn more about rain and other types of precipitation in this section.

Discover Activity

Skills Focus inferring

Materials 15 g salt, beaker, 50 mL water, stirrer, 15 mL cold water, clean test tube, crushed ice, watch or clock

Time 15 minutes

Tips The inside of the test tube must be very clean. Have students measure the temperature of the water in the test tube

L2

before they add the ice chip. They may be surprised to find that it is less than 0°C. (The freezing point of salt water is less than 0°C, the freezing point of fresh water.)

Expected Outcome When the ice chip is dropped into the test tube, the cold water

in the test tube will crystallize into ice around it.

Think It Over For hail to form, it must be very cold and there must be particles on which water can crystallize into ice.

Types of Precipitation

Teach Key Concepts

L2

Forms of Precipitation

Focus Refer students to Figures 20–22.

Teach Tell students that precipitation forms when water droplets become too large to remain in the cloud and so fall to Earth. Most water droplets in clouds never become large enough to form rain. They may fall a short distance and evaporate in the dry air that is high up in the atmosphere. Ask volunteers to read about the different types of precipitation. Then summarize how each type is formed. Ask: **What characteristics help distinguish the different forms of precipitation?** (*Size, whether they are ice crystals, and what shape and pattern they have*)

Ask: **What type of damage can be caused by freezing rain?** (*Power lines can come down, and tree branches might break under the weight.*) **By hail?** (*Large hailstones might damage crops, put dents in cars, and break car windows.*)

Apply Ask: **In summer, what do you think happens to precipitation that begins as sleet?** (*As sleet falls, it turns to rain because of the warmer temperatures of summer.*)

learning modality: visual

Independent Practice

All in One Teaching Resources

- [Guided Reading and Study Worksheet: Precipitation](#)

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Types of Precipitation

In warm parts of the world, precipitation is almost always in the form of rain. In colder regions, precipitation may fall as snow or ice. **Common types of precipitation include rain, sleet, freezing rain, snow, and hail.**

Rain The most common kind of precipitation is rain. Drops of water are called rain if they are at least 0.5 millimeter in diameter. Precipitation made up of smaller drops of water is called drizzle. Precipitation of even smaller drops is called mist. Drizzle and mist usually fall from stratus clouds.

Sleet Sometimes raindrops fall through a layer of air that is below 0°C, the freezing point of water. As they fall, the raindrops freeze into solid particles of ice. Ice particles smaller than 5 millimeters in diameter are called sleet.

Freezing Rain Sometimes raindrops falling through cold air near the ground do not freeze in the air. Instead, they freeze when they touch a cold surface. This kind of precipitation is called freezing rain. In an ice storm, a smooth, thick layer of ice builds up on every surface. The weight of the ice may break tree branches and cause them to fall onto power lines, causing power failures. Freezing rain and sleet can make sidewalks and roads slippery and dangerous.



What is sleet?

FIGURE 20

Rain and Freezing Rain

Rain is the most common form of precipitation. Freezing rain coats objects with a layer of ice.

Relating Cause and Effect What conditions are necessary for freezing rain to occur?



Go online
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 NSTA

For: Links on precipitation
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Download a worksheet that will guide students' review of Internet resources on precipitation.

Snow Often water vapor in a cloud is converted directly into ice crystals called snowflakes. Snowflakes have an endless number of different shapes and patterns, all with six sides or branches. Snowflakes often join together into larger clumps of snow in which the six-sided crystals are hard to see.



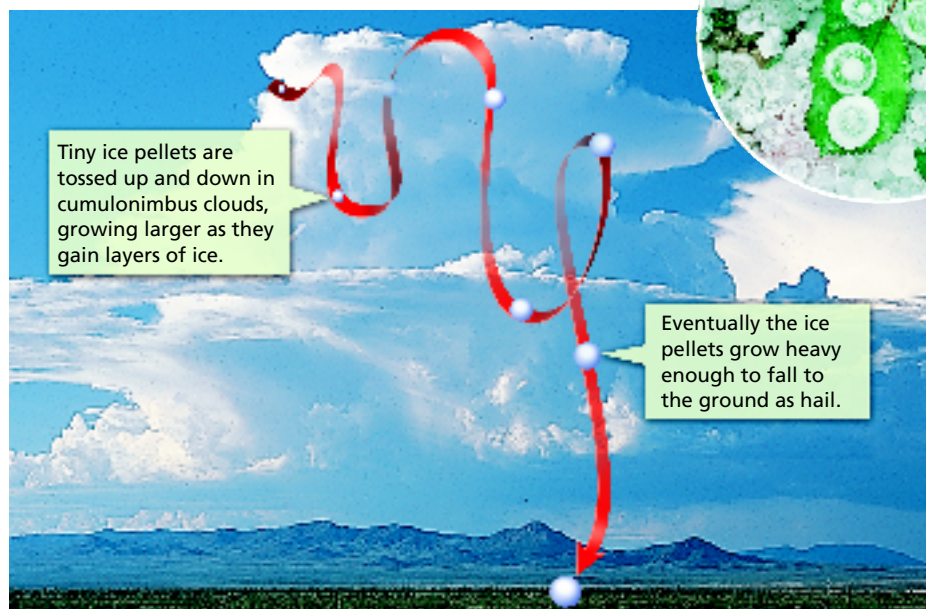
FIGURE 21
Snowflake
Snowflakes are tiny ice crystals. They all have six sides or branches.

Hail Round pellets of ice larger than 5 millimeters in diameter are called hailstones. Hail forms only inside cumulonimbus clouds during thunderstorms. A hailstone starts as an ice pellet inside a cold region of a cloud. Strong updrafts carry the hailstone up through the cold region many times. Each time the hailstone goes through the cold region, a new layer of ice forms around it. Eventually the hailstone becomes heavy enough to fall to the ground. If you cut a hailstone in half, you often see shells of ice, like the layers of an onion, as shown in Figure 22. Because hailstones can grow quite large before finally falling to the ground, hail can cause tremendous damage to crops, buildings, and vehicles.

FIGURE 22

How Hail Forms

Hailstones start as small pellets of ice in cumulonimbus clouds. They grow larger as they are repeatedly tossed up and down, until they become so heavy that they fall to the ground.



Observing Sizes of Water Droplets

Materials transparent plastic lid, dropper, pencil, water

Time 10 minutes

Focus Review how precipitation falls from clouds.

Teach Have students fill the dropper with water and squeeze many separate drops onto the inside of the lid. Then have them quickly turn the lid over and, holding it in the air by one side, use the point of a pencil from underneath the lid to move the tiny drops of water together. When the drops touch, they will appear to leap together to form larger drops; when the drops get large enough, they will fall like rain.

Apply Ask: **What causes the water drops in clouds to move around and bump into one another so that they can merge into larger drops?** (*Wind and gravity*) **learning modality: visual**

Address Misconceptions **L1**

Focus Many students think that raindrops are shaped like teardrops.

Teach Tell students that raindrops are round. Larger raindrops are flattened out like a hamburger as they fall. People may believe that rain is shaped like teardrops because symbols of rain are often drawn that way. Ask students to recall the shape of the water droplets if they did the Build Inquiry activity.

Apply Explain that the shape of raindrops often indicates their size and therefore the amount of rain that is falling. This allows meteorologists to predict possible flooding. **learning modality: logical/mathematical**

Differentiated Instruction

Special Needs

L1

Classifying Precipitation Have students divide a piece of poster board into five sections titled *Rain*, *Sleet*, *Freezing Rain*, *Hail*, and *Snow*. Students can then collect photographs of precipitation and mount them in the appropriate sections. Tell students to include a short caption and labels with each photo. **learning modality: visual**

Gifted and Talented

L3

Creating Displays Have students research and report on extreme weather (e.g., greatest accumulation of snow, largest hailstones, longest periods of rain, greatest amount of rain) in the United States. Encourage students to display their data on a map to show where the records were set. **learning modality: visual**

Monitor Progress **L2**

Oral Presentation Call on students to describe how each form of precipitation is formed.

Answer

Figure 20 Rain must first fall through a layer of cold air near the ground and then freeze on a cold surface.



Ice particles smaller than 5 mm in diameter

Measuring Precipitation

Teach Key Concepts

Instruments for Measuring Precipitation

Focus Ask students whether they have ever heard meteorologists report on amounts of rain or snow.

Teach Direct students to Figure 24. Point out that the measuring tube has exactly one-tenth the cross-sectional area of the top of the funnel. This allows meteorologists to make accurate readings to one-hundredth of an inch. Ask: **If one-tenth of an inch of rain collected in the container, what would be reported as the amount of rainfall?** (*One-hundredth of an inch*)

Apply Ask: **Why is it helpful to know the average amount of precipitation in a geographical location?** (*Sample answer: Farmers can judge which crops to plant by knowing annual averages. Towns can prepare for potential snowfall by getting the right equipment and salt for the roads.*) **learning modality: logical/mathematical**

L2



FIGURE 23
Cloud Seeding
Small planes are used to sprinkle chemicals into clouds to try to produce rain.

Modifying Precipitation Sometimes a region goes through a period of weather that is much drier than usual. Long periods of unusually low precipitation are called **droughts**. Droughts can cause great hardship.

Since the 1940s, scientists have been trying to produce rain during droughts. One method used to modify precipitation is called **cloud seeding**. In cloud seeding, tiny crystals of silver iodide and dry ice (solid carbon dioxide) are sprinkled into clouds from airplanes. Many clouds contain droplets of water which are supercooled below 0°C. The droplets don't freeze because there aren't enough solid particles around which ice crystals can form. Water vapor can condense on the particles of silver iodide, forming rain or snow. Dry ice cools the droplets even further, so that they will freeze without particles being present. However, to date cloud seeding has not been very effective in producing precipitation.



What is a drought?

Skills Activity

Calculating

Make a rain gauge by putting a funnel into a narrow, straight-sided glass jar. Here's how to calculate how much more rain your funnel collects than the jar alone.

1. First measure the diameter of the top of the funnel and square it.
Example: $4 \times 4 = 16$
2. Then measure the diameter of the bottom of the jar and square it.
Example: $2 \times 2 = 4$
3. Divide the first square by the second square.
Example: $\frac{16}{4} = 4$
4. To find the actual depth of rain that fell, divide the depth of water in the jar by the ratio from Step 3.
Example: $\frac{8 \text{ cm}}{4} = 2 \text{ cm}$

Measuring Precipitation

There are various ways to measure the amount of rain or snow. Scientists measure precipitation with various instruments, including rain gauges and measuring sticks.

Snowfall Measurement Snowfall is usually measured in two ways; using a simple measuring stick or by melting collected snow and measuring the depth of water it produces. On average, 10 centimeters of snow contains about the same amount of water as 1 centimeter of rain. However, light, fluffy snow contains far less water than heavy, wet snow.

Skills Activity

Skills Focus calculating

L3

Materials funnel; narrow, straight-sided glass jar; metric ruler

Time 15 minutes

Tips Explain that the amount of rain in the jar is the amount that fell over an area the size of the funnel opening. The total amount of rain collected must be reduced

by calculating the ratio of the diameters to show how much would have fallen into the jar alone. Make sure that students are not confused by the different ratio in Figure 24.

Expected Outcome Check that students calculated correctly.

Extend Ask: **What is the actual depth of the rain that fell if the diameter of the top diameter of the funnel is 6 cm, the bottom diameter is 2 cm, and the depth of water in the jar is 8 cm?** ($8 \text{ cm} \div 36/4 = 0.89 \text{ cm}$) **learning modality: logical/mathematical**

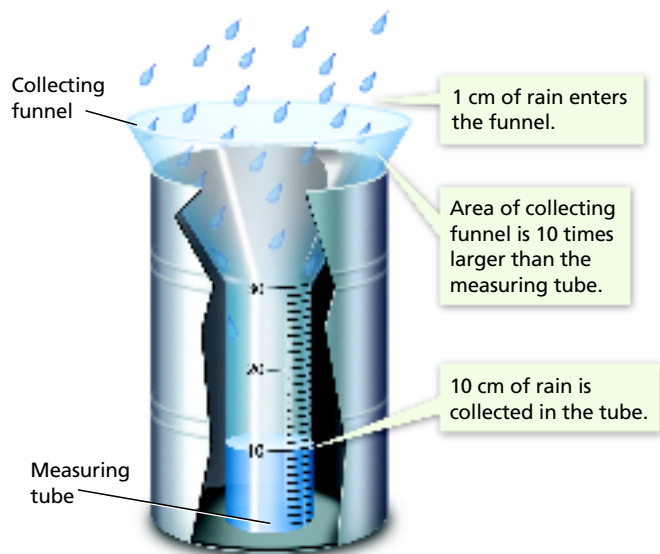


FIGURE 24
Rain Gauge
A rain gauge measures the depth of rain that falls.
Observing How much rain was collected in the measuring tube of this rain gauge?

Rain Measurements An open-ended can or tube that collects rainfall is called a **rain gauge**. The amount of rainfall is measured by dipping a ruler into the water or by reading a marked scale. To increase the accuracy of the measurement, the top of a rain gauge may have a funnel that collects ten times as much rain as the tube alone, as shown in Figure 24. The funnel collects a greater depth of water that is easier to measure. To get the actual depth of rain, it is necessary to divide by ten. The narrow opening of the tube helps to minimize evaporation.

Section 5 Assessment

Target Reading Skill Using Prior Knowledge
Review your graphic organizer about precipitation and revise it based on what you have learned.

Reviewing Key Concepts

1. **a. Listing** Name the five common types of precipitation.
- b. Comparing and Contrasting** Compare and contrast freezing rain and sleet.
- c. Classifying** A thunderstorm produces precipitation in the form of ice particles that are about 6 millimeters in diameter. What type of precipitation would this be?
- d. Relating Cause and Effect** How do hailstones become so large in cumulonimbus clouds?

2. **a. Identifying** How can a rain gauge be used to measure precipitation?
- b. Explaining** How does the funnel in a rain gauge increase the accuracy of the measurement?

Writing in Science

Firsthand Account Think about the most exciting experience you have had with precipitation. Write a paragraph about that event. Make sure you describe the precipitation itself as well as the effect it had on you.

Monitor Progress L2

Answers

Figure 24 10 cm



A long period of unusually low precipitation

Assess

Reviewing Key Concepts

1. **a.** Rain, sleet, freezing rain, hail, and snow **b.** Both form when rain falls through a layer of cold air near the surface. Sleet occurs when the rain freezes in this cold layer of air. Freezing rain occurs when the rain freezes on cold surfaces. **c.** Hail **d.** The stones are tossed up and down in the clouds. As the stones move through the cold regions of the clouds, additional ice layers are added.
2. **a.** Rain falls into the gauge and the amount gathered can be read from a scale. Actual rainfall must be calculated based on the ratio of the area of the top of the funnel to the area of the bottom of the jar. **b.** The funnel allows the rain gauge to collect ten times as much rain as a rain gauge with just a tube, so the rainfall can be measured more easily and accurately.

Reteach

List the five types of precipitation, and have students write a definition of each.

Performance Assessment L1

Have students draw diagrams showing how rain, sleet, and freezing rain form.

All in One Teaching Resources

- [Section Summary: Precipitation](#)
- [Review and Reinforce: Precipitation](#)
- [Enrich: Precipitation](#)

Lab Zone Chapter Project

Keep Students on Track Ensure that students have finished building their instruments and have begun collecting and recording data. Provide assistance with instruments that don't work. Help students redesign their instruments if necessary. Encourage them to share ideas with classmates about what works and what doesn't.

Writing in Science

Writing mode: Description

Scoring Rubric

- 4 Exceeds expectations by completely describing an exciting experience with precipitation and including details about the precipitation and the effects on the student
- 3 Meets expectations by addressing all the criteria
- 2 Includes some minor omissions or errors
- 1 Includes major omissions or errors